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A Preliminary Framework for Feedback Mechanism Design in Extended Decision Support Systems-Implications of a Literature Review

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A PRELIMINARY FRAMEWORK FOR FEEDBACK MECHANISM DESIGN IN EXTENDED DECISION SUPPORT SYSTEMS – IMPLICATIONS OF A LITERATURE REVIEW

Poster Abstract

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Abstract

To help humans in making decisions, decision support system (DSS) commonly apply concepts based on logic and mathematics which are often perceived as hard to handle. Feedback mechanisms providing decisional guidance are suggested to be viable means to solve the problem and render DSS into extended DSS. While known to be effective to enhance decision making in a more human centric way, guiding feedback mechanisms are still rarely implemented in DSS. This is suggested due to the lack of practically implementable design guidelines. This paper presents a preliminary framework based on four layers of human computer interaction (HCI) interface design, which comprises the insights gained in a systematic literature review on DSS feedback mechanisms from a HCI perspective.

Keywords: Extended decision support systems, feedback mechanisms, human computer interaction, decisional guidance.

1 Introduction

Decision support systems (DSS) are computer systems providing features to extend the cognitive decision making abilities of its users (Zachary, 1988). These features commonly use concepts based on logic and mathematics which give intuitive and feeling people a hard time to understand and use these tools (Lu et al., 2001; Chenoweth et al., 2004). Decisional guidance suggests that DSS may be improved by guiding the user through the decision process (Silver, 1991). As feedback is known to be an effective means to persuade humans in engaging or avoiding specific behavior (Kluger and DeNisi, 1996), this research focuses on persuasion through feedback mechanisms. Providing such support in using and understanding a DSS is suggested to render standard DSS into extended DSS (Singh and Singh, 1997).

While known to be effective to enhance decision making, guiding feedback mechanisms are still rarely implemented in DSS. This is suggested to be due to the lack of practically implementable design guidelines (Te'eni, 1991, 1992). To put more insight into this problem the underlying research aims at exploring DSS feedback mechanism design from a human computer interaction (HCI) perspective. Based on the findings of a systematic literature review, this paper proposes a preliminary framework for feedback mechanism design in extended DSS based on four layers of HCI interface design issues (Preece et al., 1987).

2 Feedback mechanisms from decision making and HCI perspective

Back in 1992 a process feedback framework for information systems was proposed (Te'eni, 1992). It especially aimed at systems supporting decision making. In this framework feedback is defined as

process feedback which provides information on the user's decision making process with the intention to support the user through modifying decision behavior. To intentionally control user behavior the process feedback framework considers three categories of feedback design characteristics to be important: the feedback's objectives, its content, and its form and timing.

In contrast, feedback in HCI is understood in a broader sense, comprising all user triggered communication from the system to the user (Renaud and Cooper, 2000). From the HCI viewpoint, a feedback mechanism may not only be designed with the intention to modify the user's behavior, but instead to simply signify a response, or solely to promote understanding of the system's state. All these types of information presentation are potentially persuasive (Oinas-Kukkonen and Harjumaa, 2009). However, on the level of decisional guidance behavioral change is designed intentionally (Silver, 1991).

3 A preliminary framework for DSS feedback mechanisms

According to the literature review conducted in advance, the main research foci of literature on feedback mechanisms in DSS can be applied to four design issues of HCI interfaces (Preece et al., 1987). These issues consist of conceptual design, semantic design, syntactic design and lexical design issues and appear to be compatible with the categories of process feedback characteristics presented earlier. Both approaches propose the design issues to be mutually interconnected and hierarchically structured (Moran, 1981; Te'eni, 1992). The preliminary framework, summarized in Table 1, is based on these assumptions and proposes a framework consisting of four feedback mechanism design layers.

Layer	**Description**	**Characteristic examples**
Conceptual layer	Feedback model	Objectives, information type (OI, TI, CI, FVI)
Semantic layer	Content	Raw data, methods, explanations (feedforward)
Syntactic layer	Trigger	Timing, user age, feedback count
Lexical layer	Presentation	Text, graphics

Table 1. Overview on a preliminary framework for feedback mechanism design to provide decisional guidance in extended DSS.

On the conceptual design level reside the basic application concepts (Preece et al., 1987). These concepts are also referred to as the conceptual model or the user model. In the preliminary framework on this layer the feedback model roughly describes the general concept of the feedback mechanism and its design objectives. The general type of information to provide (e.g.: outcome information (OI), task information (TI), cognitive information (CI), or functional validity information (FVI) (Balzer et al., 1989)) is a possible example of an issue described by the feedback model.

The semantic design defines which information is needed for each action (Preece et al., 1987). In the process feedback framework this information is represented through the content provided in a feedback message (Te'eni, 1992). Possible feedback mechanism characteristics related to the semantic layer may be which raw data (measurement) to provide, which calculation methods to use for data aggregation, or which related explanations to provide to clarify the message's meaning. Latter information on explanations is also referred to as feedforward information (Kayande et al., 2009).

In HCI interface design syntactic design issues concern with the sequence of system inputs and outputs (Preece et al., 1987). This is comparable to the concept of feedback timing in the in the process feedback framework (Te'eni, 1992). In the proposed framework a broader interpretation of the syntactic design layer is used. Here, the syntactic layer is suggested to define the feedback's trigger, that is the conditions when to release the signal. Following this idea other constraints, for instance constraints based on user or contextual characteristics (e.g.: user age, times feedback was given), are also related to this layer.

Finally, lexical design issues describe how input and output functionality is represented by the available hardware primitives (Preece et al., 1987). Applied to feedback mechanism design this is how information is expressed by the means of the selected communication channel. An example of feedback mechanism characteristics of this layer may be to provide information as either text or graphical depiction.

4 Conclusion

In this paper a preliminary framework was presented to provide an overview on the general ideas drawn from a previous literature review. By providing a HCI view on existing literature, the proposed framework is suggested to provide an interesting theoretical contribution to the research area of DSS feedback, which also provides practical implications by integrating HCI principles. However, as the framework is preliminary, future research should further refine this framework by suggesting and testing new feedback characteristics.

References

Balzer, W. K., Doherty, M. E. and O'Connor, R. (1989). "Effects of cognitive feedback on performance." *Psychological Bulletin*, 106 (3), 410–433.

Chenoweth, T., Dowling, K. L. and St. Louis, R. D. (2004). "Convincing DSS users that complex models are worth the effort." *Decision Support Systems*, 37 (1), 71–82.

Kayande, U., De Bruyn, A., Lilien, G. L., Rangaswamy, A. and Van Bruggen, G. H. (2009). "How Incorporating Feedback Mechanisms in a DSS Affects DSS Evaluations." *Information Systems Research*, 20 (4), 527–546.

Kluger, A. N. and DeNisi, A. S. (1996). "The Effects of Feedback Interventions on Performance: A Historical Review, a Meta-Analysis, and a Preliminary Feedback Intervention Theory." *Psychological Bulletin*, 119 (2), 254–284.

Lu, H.-P., Yu, H.-J. and Lu, S. S. . (2001). "The effects of cognitive style and model type on DSS acceptance: An empirical study." *European Journal of Operational Research*, 131 (3), 649–663.

Moran, T. P. (1981). "The Command Language Grammar: a representation for the user interface of interactive computer systems." *International Journal of Man-Machine Studies*, 15 (1), 3–50.

Oinas-Kukkonen, H. and Harjumaa, M. (2009). "Persuasive Systems Design: Key Issues, Process Model, and System Features." *Communications of the Association for Information Systems*, 24 (1), 485–500.

Preece, J., Woodman, M., Ince, D. C., Griffiths, R. and Davies, G. (1987). "Towards a structured approach to specifying user interface design." In: *Proceedings of the INTERACT'87 Conference on Human Computer Interaction*, pp. 415–421.

Renaud, K. and Cooper, R. (2000). "Feedback in human-computer interaction-characteristics and recommendations." *South African Computer Journal*, (26), p-105.

Silver, M. S. (1991). "Decisional Guidance for Computer-based Decision Support." *MIS Quarterly*, 15 (1), 105–122.

Singh, D. T. and Singh, P. P. (1997). "Aiding DSS users in the use of complex OR models." *Annals of Operations Research*, 72 (0), 5–27.

Te'eni, D. (1991). "Feedback in DSS as a Source of Control: Experiments with the Timing of Feedback." *Decision Sciences*, 22 (3), 644–655.

Te'eni, D. (1992). "Analysis and design of process feedback in information systems: old and new wine in new bottles." *Accounting, Management and Information Technologies*, 2 (1), 1–18.

Zachary, W. W. (1988). "Decision Support Systems: Designing to Extend the Cognitive Limits." In: *Handbook of Human-Computer Interaction* Ed. by M. G. Helander, pp. 997–1030.